

Is breeding in the city a walk in the park?

The effects of 'urban-ness' & climate change in an iconic British songbird

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1 Background: Ecological research comparing songbird populations in urban, suburban and rural areas has revealed how city environments impact populations, communities, and ecological interactions. For example urban birds breed earlier and raise fewer to chicks to fledging than their rural counterparts. (Chamberlain *et al.* 2009).

However, little is known about how breeding may be influenced by fine-scale environmental changes within the complex cityscape, including those driven by climate change. This requires studying organisms at spatial scales relevant to their experience of the environment (for songbirds metres to km). This approach is key to better understanding the capacity of wildlife populations to cope with the threat from multiple stresses and rapidly changing environments. (Cole *et al.* 2015; Moll *et al.* 2019).



Methods: Focal species: Blue Tits: common European cavity-nesting species and known urban adaptor. **Study design:** Nested study design: 310 nestboxes distributed across 31 sites. **Data Collection:** 6 years (2013-2018). **Breeding data variables:** Laying date, hatching date, incubation time, fledging date, clutch size, max. brood size, number of fledglings. Nestling body condition assessed using measurements of body mass & tarsus (8-12 days post-hatching.)



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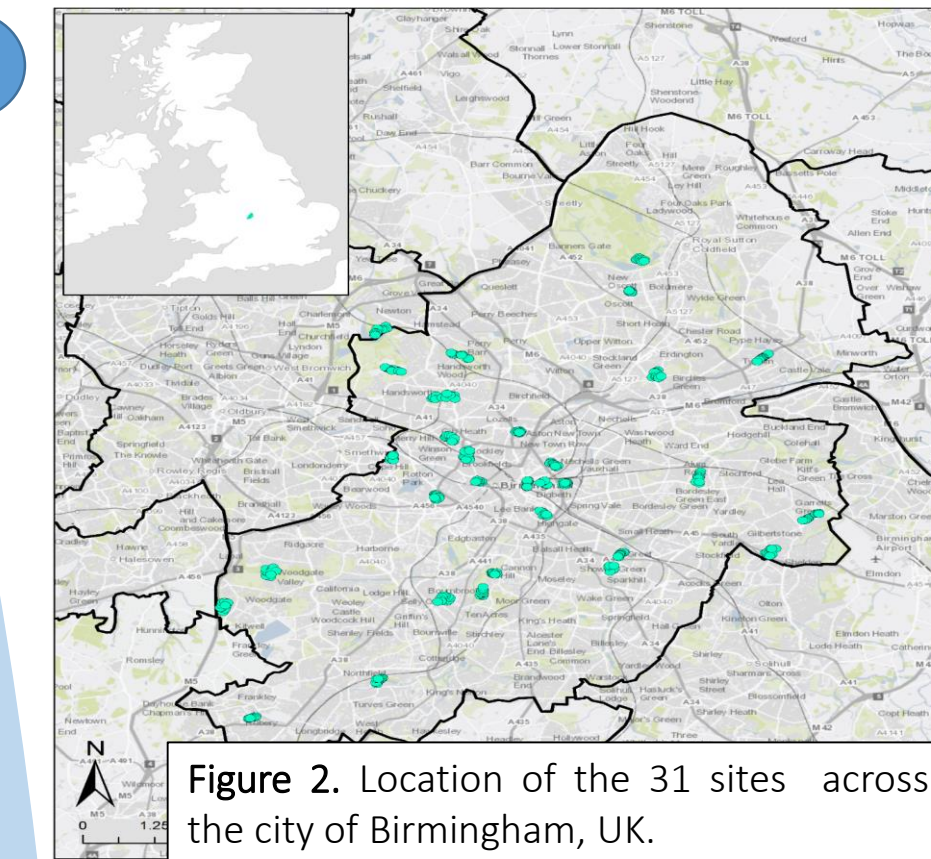


Figure 2. Location of the 31 sites across the city of Birmingham, UK.

Study Sites: 31 sites (Fig. 2) selected following quantification in GIS. Site selection ensured we captured a continuum of urbanization (an 'urban gradient'). Each site visited weekly March through June.

Figure 3 (below): typical site set-up. 10 nest boxes $\geq 50m$ apart.



Figure 3. Example of experimental set-up at Soho Park in Birmingham, UK.

Tiny tags and ibuttons installed to record temperature at edge and centre of each site (logging rates of 5 and 15mins) in 2017 and 2018.

2 Aim: Our project investigates the influence of fine-scale spatial and temporal variation in landscape and weather variables within a city on breeding timing and breeding success for a common urban bird: the Blue Tit (*Cyanistes caeruleus*).

3 Study Area & Site Selection: Birmingham, UK.

'Urban-ness' of sites quantified using landscape characteristics associated with cities & surrounding regions (e.g. habitat connectivity, green [tree] cover, built landcover). Buffer zones defined for each site (red circles in Fig. 1) at different spatial scales (250 m & 1 km shown). Built cover (grey shading) & tree cover (green shading) quantified within buffer zones for each site.

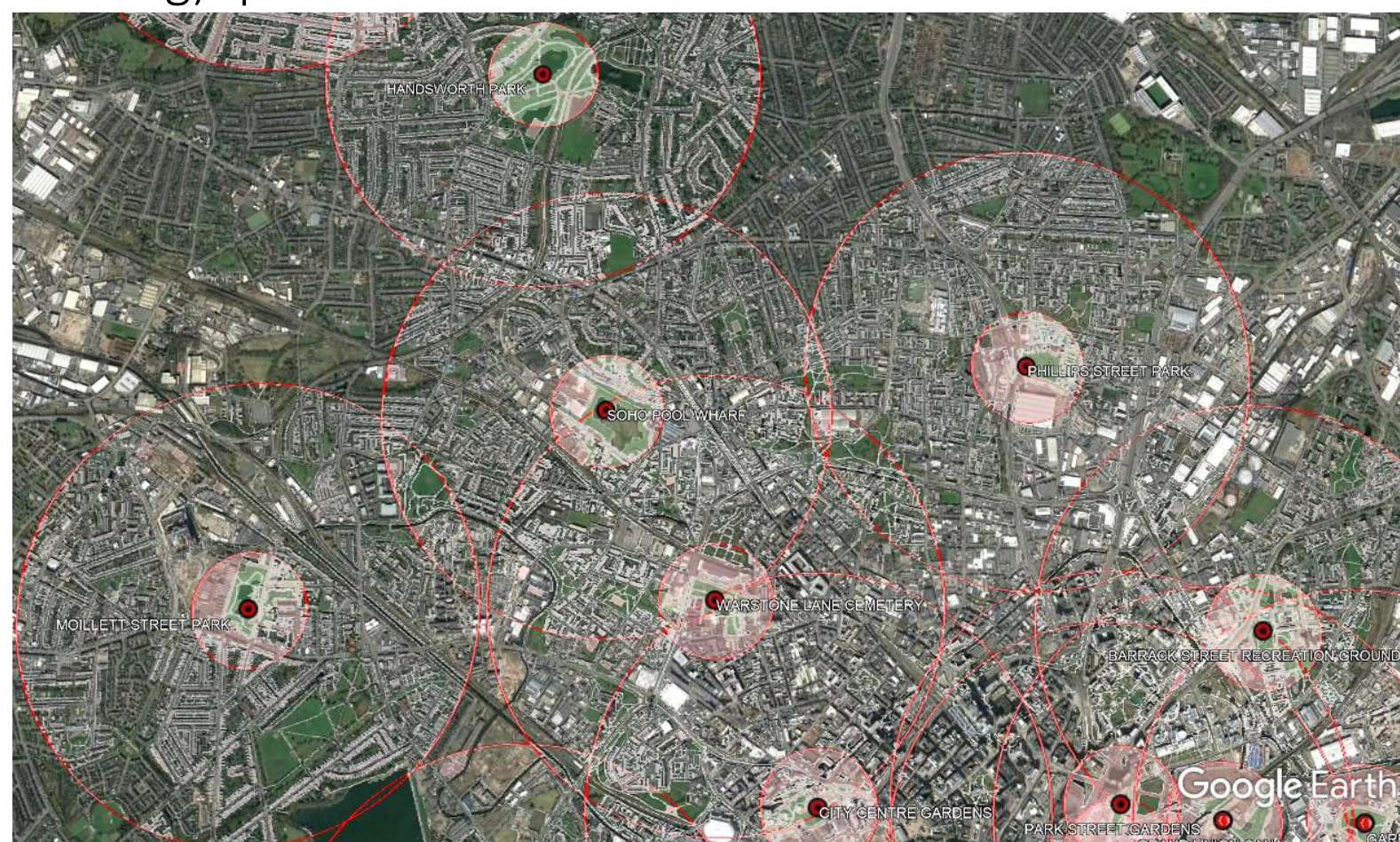


Figure 1. Identifying landcover types within buffer zones to aid site selection.

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We modelled landscape parameters with breeding timings and outcomes at different spatial scales, from individual nesting attempts, to inter-site and the city-wide population level. Here are just a small selection of our results.

Results:

- Considerable variability in the timings & outcomes of different stages of the breeding cycle, within & between nest sites & years. Figs. 4a and 4b illustrate variation in April laying date & fledging success with increasing built landcover (500m buffer zone).
- Clutch size remained constant across years & urban gradient.
- No significant effect of built landcover (i.e. urban gradient).**
- Year is a significant predictor in explaining breeding timing (laying date: $F = 127.90$, $P < 0.001$).

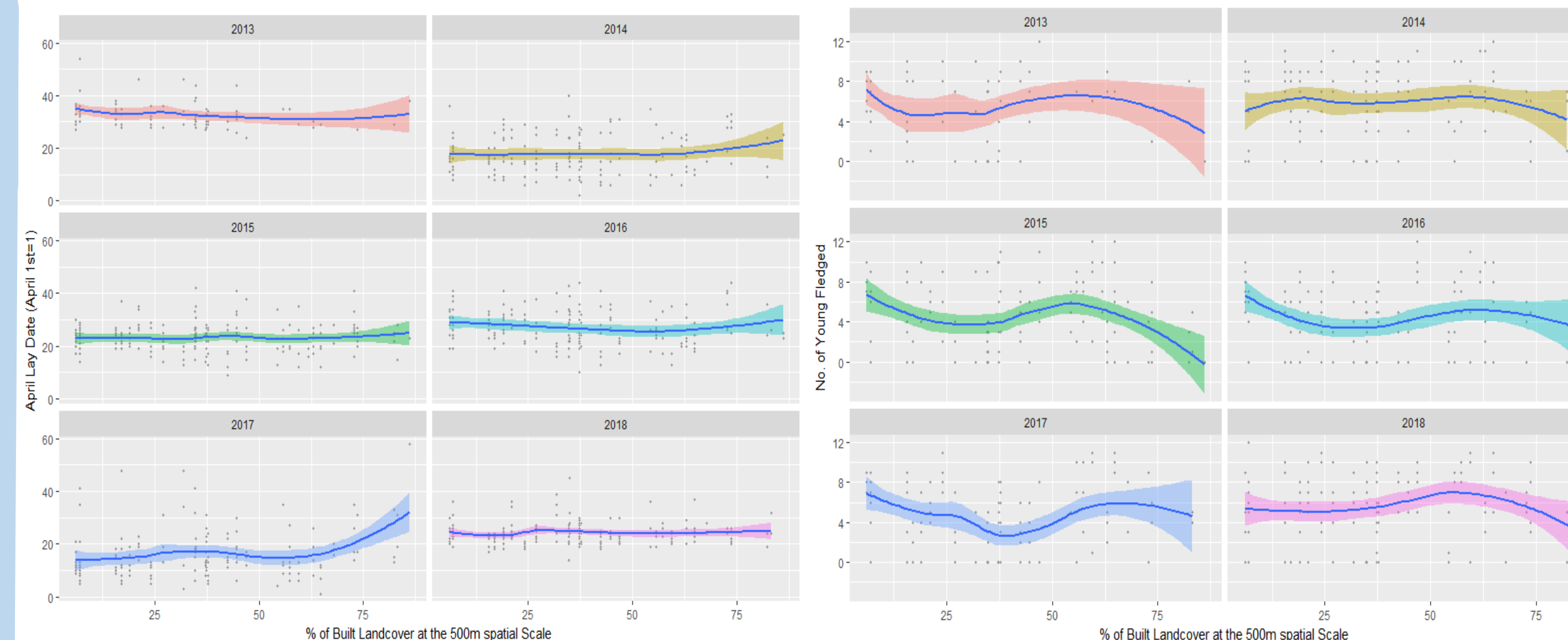


Figure 4: . plots of relationships between urban cover (calculated as the % of urban cover at the 500 m spatial scale), and (a) April laying date, (b) number of fledged young.

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Conclusions & next steps: Biotic responses, even in urban-adapted species, are complex & likely influenced by many interacting environmental variables. But which variables are driving the striking variation in breeding timings and breeding outcomes in our urban Blue tit population? We believe weather and extreme weather events (EWEs) associated with climate change may be key.

The next phase of our Birmingham research is investigating :

- if variability in temperature & rainfall during the breeding season drives variation in breeding timing and success between years/across the urban gradient.
- the impacts of extreme weather events on breeding biology
- if impacts of extreme weather on breeding are exacerbated or buffered by increasing levels of urbanisation.

This research will improve our understanding of how breeding responses in birds are influenced by multiple environmental stresses, whilst providing insights that will help in effective greenspace planning....crucial for wildlife to maintain viable populations.

References: Chamberlain *et al.* (2009) *Ibis* **151**, 1-18 ; Cole *et al.* (2015) *Ecol Evol* **5**, 5057-5074; Moll *et al.* (2019) *J Appl Ecol* **56**, 1289-1300; **Acknowledgements:** Photos: Andrew Mason & Author (<https://www.andrewmasonphoto.com>); Map: Helen Pearce (UoB), Blue Tit: Kit Harcourt (UMass Amherst)